

# OCCUPATIONAL KNOWLEDGE UTILITIES IN INTERNATIONAL BUSINESS AND ECONOMICS

Opie L. Dawson

*Emeritus Professor, The University of Texas at El Paso*

Jay S. Kang

*San Francisco State University*

## ABSTRACT

*Internet occupational knowledge utilities (OKUs) can aid nations in international trade in applying fair means to improve their comparative advantage. For this purpose properly developed OKUs can provide the knowledge base needed to:*

- *Enhance a nation's productivity through improved training of its workforce.*
- *Enhance the growth of small business – a powerful source of innovation in all industries.*
- *Cut costs and increase markets through use of automation technology and E-commerce.*
- *Enhance capital investment through the action of the above activities.*

*We present the need, solution, conceptual schema, technology, funding and motivation required in the development of such OKUs.*

*Keywords: Occupational Knowledge Utilities, National Industrial Policy, Dynamic Comparative Advantage, Workforce Training, Small Business Development*

## INTRODUCTION

The philosopher Sir Francis Bacon, in 1597, stated that knowledge is power. The term utility is often used to refer to a public power-producing facility. Adopting this suggestive terminology, we envision a need for a large occupational knowledge utility, an "OKU", that will permit its users, who need the power of a particular item of occupational knowledge, to find it quickly on an appropriate Internet system. The system would provide verified, accurate, timely, reliable and well-filtered information and knowledge about processes, methods, and practices used in the occupation in which each user is interested. Such a system might also be referred to as a

“knowledge management system”, in that it serves to aid in collecting, filtering, storing, and distributing information to be available to users as knowledge.

Internet occupational knowledge utilities should be provided to deliver their services and benefits to our citizens. They provide up-to-date, authoritative, and rigorously filtered knowledge for those seeking to build businesses, find employment, or develop their knowledge base. Their intent in this regard will fulfill as-yet-undelivered promises of an information superhighway. These considerations pertain to all such utilities, whether publicly or privately funded.

As most citizens understand today, the Internet, one of the most exciting developments in technology of the last century, has tremendous potential. It remains the job of the new millennium to insure that the technology delivers on that potential. Unfortunately, while the Internet offers a wealth of information today, it is often very difficult if not impossible to find the exact information one wants or needs. In addition, the search required to obtain the information needed is far too time-consuming. Finally, even though the information is found, one often cannot assure its veracity.

The picture that emerges from an extensive review of the sources outlined in the attached bibliography is the general need for knowledge management tools. These tools are often available only to large firms with highly paid consultants and unlimited access to the ‘fertile’ side of the “digital divide”. The lack of availability and accessibility of these tools inhibits the growth of individuals and small businesses in particular. In turn, it also inhibits the ability of a nation to attain and continue in a position as a productivity leader on a global basis.

Historically, library systems have been a significant repository of a nation's knowledge base. People used libraries and their librarians to obtain the knowledge they needed to go boldly in new directions. Today, libraries can no longer fulfill this function because they are under-funded. Also, the amount of information we are generating is too great to be handled by manual processes and individuals. However, business requires knowledge at the fastest rate possible. The need for instantaneous access to consistent filtered knowledge is compelling. The old paradigm is no longer acceptable. The world needs knowledge utilities, and in particular the OKUs which will benefit workers and entrepreneurs who are involved in international trade.

We envision OKUs to be useful in facilitating and expanding world trade as well as in developing the wealth of emerging national economies that may become new partners with existing trading nations.

In developing OKUs it is important to avoid interference with private enterprise to the greatest possible extent. This means the system must be regulated internally and otherwise as necessary. It is our belief, therefore, that the development of OKUs should be realized with the aid of governing entities and not by private enterprise and free markets alone.

Some examples of potential users of an OKU include:

- an international business person who is examining various business occupation in order to gain knowledge useful in planning, staffing, organizing, and otherwise implementing a new business;
- a worker who is entering the workforce and seeks to locate the kind of employment best suited to his or her educational and skill level;
- a worker who needs to remain current in an occupation the nature of which is changing rapidly because of scientific, technological, economic, or other sociological changes;
- a worker engaged in a consulting or an advising discipline across a range of occupations who needs specific and/or up-to-date information relevant to the occupation of a client firm or person;
- a worker who reaches a supervisory or management level in his or her occupation and needs to fill himself or herself in on aspects of other specialties within the scope of his or her
- new responsibilities; and
- those whose regulatory responsibilities include understanding of the work requirements of the industries they are charged with overseeing.

While the above provides a sample of possible users, it is certainly not an exhaustive listing of all the possibilities.

### *Methodology*

This is a theoretical work, but it is based on an extensive review of the applicable literature which contains supporting empirical studies, as well as authoritative analyses and reference to practical methods useful in its application. Our methodology is that of research in the applied sciences. In this regard we rely on the following presentation:

Both pure and applied sciences fulfill a cognitive as well as an instrumental task, but in each branch these two ingredients are mixed in different proportions. Roughly speaking one might say that the cognitive element dominates pure science – all of its statements have a sufficiently high degree of reliability as to be assumed true, but their specific usefulness may not be established; whereas the instrumental element dominates applied science – all of its statements are assumed to be useful but their degree of reliability is not necessarily high enough to regard them as true in the conventional sense. Thus the applied sciences use the same methods as the pure ones (observation and measurement, induction and deduction, interpretation and testing, etc.) but with a fairly specific purpose in mind, and under consideration of an economic or cost-benefit criterion. The distinction between pure and applied science is not simply that between ‘knowing’ and ‘doing’, but rather that between ‘believing

for the sake of knowing' and 'believing for the sake of doing'. And since epistemology cannot restrict its concern to knowing but must be equally concerned with believing, the philosophy of both pure as well as applied science belongs to it. (Mattessich 1977, 7)

## **THE BASIC ELEMENTS OF AN OKU**

The system should supplement, complement, and coordinate with, but not replace existing educational, training, or other professional, trade and business consulting or information providing entities. The content of an OKU should originate with appropriate business professionals and other qualified individuals in various industries. Educators from relevant business disciplines and those who provide occupational training should guide filtering of content. An OKU should not be used as an employment service, or advertising medium. These requirements indicate the need for standard setting entities to insure appropriate implementation. While privately funded Internet knowledge utilities focusing on the workplace may be developed and continue to evolve, the scope of the requirements just listed is broad enough to indicate a foreseeable need for publicly funded and regulated OKUs.

### *Standards*

Standards to insure the appropriateness of the content of OKUs are certainly a necessity. The Financial Accounting Standards Board has documented such standards in various concept statements for the accounting profession. The following summary of the FASB point of view is based on a diagram in the work "A Conceptual and Institutional Approach: Accounting Theory" entitled "A Hierarchy of Accounting Qualities." (Wolk, Tearney, and Dodd 2001, 211).

The top of the hierarchical listing begins with user's view ---

- "Users of the Accounting Information are Decision Makers defined by Their Characteristics (for example, understanding or prior knowledge),"

Stemming from the user's view is the ---

"Pervasive Constraint of Benefit > Costs,"

Then follows ---

- "User-Specific Qualities: Understandability and Decision Usefulness,"
- "Primary Decision-Specific Qualities" - interrelated and including as ingredients:
  - "Relevance (Predictive Value, Feedback Value, and Timeliness),"
  - "Reliability (Verifiability, Neutrality and Representational Faithfulness)."
- "Secondary and Interactive Qualities"--"Comparability (Including Consistency),"
- And finally the "Threshold for Recognition: Materiality."

This summary is fully elucidated in the reference. Similar appropriate statements of conceptual standards will no doubt be adopted by organizations of other interdisciplinary professional business consultants, particularly when the American Institute of Certified Public Accountants complementary “Global Business Credential” comes into being. These works can provide a model for the development of standards for administering the information content of OKUs.

### *Needs and Requirements*

Ultimately as an aid in solving the problem of the so-called 'digital divide' the national occupational utility might share the existing infrastructure of the Internet. It could be associated with it through public funding, but separate from it in operation and regulation in order to avoid interference with and from activities of private enterprise. It should, however, permit non-interfering references and cooperation between these entities. Thus, it would provide open access, for all, to filtered, reliable, and relevant business and workplace information – knowledge – which exists in the public domain.

Today, increasingly, work requires specific knowledge regarding the processes for producing goods and services. Also there are rapid changes in the scale and volume of such knowledge requirements. Thus “knowledge workers” need ongoing access to a knowledge utility that provides well-organized means of accessing information going beyond library and other existing information cataloging and distribution systems. And such a knowledge utility is not presently available in existing Internet search and artificial intelligence systems. However, valuable elements of these entities certainly can be useful in preparing the structure for acquiring the information needed by OKUs.

Other considerations with regard to needs and requirements for OKUs include:

- An OKU, like any useful cataloging system, should provide the means for the user to find the information and knowledge which he or she needs relating to the goods or services in which he or she is interested. In other words, the system should provide quick and easy accessibility to work-relevant knowledge.
- An OKU should present materials in a form understandable to the user taking into consideration his or her level of education, culture, language, gender, generation, etc.
- An OKU should also make a maximum use of the techniques developed over the years by behavioral psychologists in training an individual's skills. These include "expert systems" and maximum use of audio visual, programmed materials which rapidly advancing Internet technology will soon make practical and efficient.

In summary, an OKU should provide the knowledge and the accompanying skills to workers at all levels in the work place that will permit them to find, maintain, and be productive in work and in forming new businesses. This will aid in solving problems or situations such as:

- the condition commonly referred to as the “digital divide”;
- “the information glut” (Shenk 1997);
- building wealth under “the new rules for individuals, companies, and nations in a knowledge-based economy” (Thurow 1999);
- the deficiencies in the training of the workforce in the United States and possibly in other industrial as well as emerging economies (National Center on Education and the Economy 1990);
- meeting the needs of the workforces of industrial nations which to an increasing extent are comprised of those who have been termed 'free agents', namely, temporaries, consultants, telecommuters, start-up entrepreneurs, and other 'free lancers' (Adler and Nayyar 2000); and
- Enhancing E-commerce by small business as well as large via the Internet, “an increasingly important driving force in the emerging global marketplace.” (da Costa 2001)

We omit here detailed discussion of the many relatively well known facts regarding the impact of electronic technology on world trade, or of the actions presently being taken by many nations, the World Trade Organization, and World Bank to meet the challenges involved. These actions, however, involve all nations through the application of '*dynamic comparative advantage*' concepts [as opposed to conventional, 'static' comparative advantage theories] in formulating national industrial policies. Such formulations have been described in this way: “The Japanese were among the first to recognize that comparative advantage in a particular industry can be created through the mobilization of skilled labor, technology, and capital. They also realized that, in addition to the business sector, government can establish [national industrial] policies to promote change through time. Such a process is known as *dynamic comparative advantage*.” (Carbaugh 2000, 96)

Of course, in the implementation of a proposal, particularly one of huge scope such as we present here, there are many considerations to keep in mind. Some of these, as presented in authoritative works, references, and the daily media, include obtaining public recognition of the relevant needs. Accepting the possibility of some redundancy in our listing, these considerations include:

- Emerging and established industrial nations attempt to improve their positions in international trade through 'national industrial policies' based on the concepts of 'dynamic comparative advantage'.

- 'National trade policies' need to be regulated by the United Nations, the International Monetary Fund, the World Bank, and other international entities including the World Trade Organization to insure fairness and equity among the trading entities, and promote the emergence of new trading entities and the consequent expansion of markets, with opportunities for all.
- World trade in the emerging economy is driven by knowledge, particularly at present, and by associated technological advances in automation, communications, information processing, and knowledge management.
- Maintaining the balance between supply and demand for products and services across the spectrum of trading nations is perhaps the primary challenge facing the world economy today, and it is considered most essential to world peace and prosperity.
- Training of workers in the industrial nations, particularly with respect to the preparation and transition of non-college students to the workforce is a problem even in the most advanced economies. (National Center on Education and the Economy 1990).
- Training of workers in emerging trading nations and those not presently engaged in any international trade is essential to future world prosperity and peace.
- Technological advances are creating rapid changes in the workplace and fears in workers with income levels in the lower two thirds of the population as expressed in demonstrations at recent meetings of the World Trade Organization.

### **THE DESIGN: A CONCEPTUAL SCHEMA FOR AN OKU**

In the present rapidly changing situation, this overall, conceptual schema for an OKU should be considered illustrative only and in no way intended to be limiting or comprehensive. The schema is based on the United States situation, but is intended to be relevant to all national situations and as a possible basis for standardization internationally.

A specific OKU should consist of a comprehensive set of the necessary relational databases to accomplish the purposes as envisioned and defined above. A conceptual schema for an individual database is said to consist of "a view of the total database content." (Date 1982) The schema provides classification systems equivalent in purpose to those of libraries. It, of course, also contains knowledge items in contextual form, and in the near future may very well contain audiovisual-programmed materials as well. The databases we are discussing will be located on the Internet. The conceptual schema in this section presents only the high-level categories of entities of concern that can be found in tables of an OKU database, namely:

- The North American Industrial Classification System Dimension Table (Executive Office of the President 1977) that contains attributes [domain columns] such as a name and a numerical code for each industry listed. These attributes or “domains” as they are called in database terminology are contained in columns of the aforementioned table.
- The Functional Position Dimension Table with the names and numerical code columns for workers’ positions from CEO through managerial and supervisory positions within the usual or common organizational framework of companies.
- The table of the O\*Net Program database of the United States Department of Labor (2001) which has recently replaced the Dictionary of Occupational Titles and provides a comprehensive means of categorizing job descriptions. The descriptions themselves should be useful in preparing cell content as well as in the cataloging and categorizing phase of database development.

These three conceptual schemata can provide general information about the content of the cells. Further cataloging tables and specific domain columns are described later under the section on *Technology*. Appropriate materials of this nature will need to be determined industry by industry as development proceeds. However, the three schemata can provide a framework within which a programmed user interface will aid the user in quickly finding the knowledge he or she needs.

### *The Content of the Cells of the OKU Matrix*

Each cell within this matrix would contain a relational database of filtered and validated information --- available knowledge --- with respect to relevant products and services. The cell focus would utilize the journalistic frame of reference for analyzing events, and it would provide the 'who, what, when, where, why, and as appropriate, how' of workplace production and other processes. The content could be viewed generally as consisting of, for each process, practice, method, and product or service discussed, knowledge items including knowledge-based expert systems. Harmon and King (1985, 5) define an expert system as follows:

. . . [an expert system is] an intelligent computer program that uses knowledge and inference procedures to solve problems that are difficult enough to require significant human expertise for their solution. Knowledge necessary to perform at such a level, plus the inference procedures used, can be thought of as a model of the expertise of the best practitioners of the field. The knowledge of an expert system consists of facts and heuristics. The 'facts' constitute a body of information that is widely shared, publicly available, and generally agreed upon by experts in a field. The 'heuristics' are mostly private, little-discussed rules of good judgment (rules of plausible reasoning, rules of good guessing) that characterize expert-level decision making in the field. The performance level of an expert system is primarily a function of the size and the

quality of a knowledge base it possesses.

The cost of developing expert systems is a significant consideration. Cost-benefit analysis will be always in order. However, sophisticated programming tools to assist in the development of expert systems should become available. This would facilitate the development of the content of the cells of OKU databases.

A most likely component of the cells will be data from the new United States Department of Labor O\* NET, the Occupational Information Network. It is said to be “replacing the Dictionary of Occupational Titles (DOT) as a source of occupational information. O\* NET is a database— not a book, like the DOT. This database has the qualities of both an interactive library and a language. Serving as a library for information on the working world, O\* NET allows everyone to access data on job characteristics and worker attributes. It includes information on the knowledge, skills, abilities, interests, preparation, contexts, and tasks associated with 1,122 O\* NET occupations. Like a spoken language, O\* NET acts as a medium for exchanging information.” (Department of Labor 2001) Workers who are exploring career information on O\*NET can learn about which skills various employers seek for specific types of work. Employers identify necessary skills to increase the efficiency of recruitment and training. Educational planners need O\* NET to design instructional programs that teach the skills demanded in the workplace.

The O\*Net database will permit inclusion of all job descriptions needed in fully developing each cell in the basic OKU matrix, which implies that there may be a great deal of redundancy of data in the total matrix. However, it appears this problem can be resolved by the new XML, Extensible Markup Language, as discussed later in the section on Technology.

## **TECHNOLOGY FOR THE OKU**

Michael Dertouzos (1999) emphasized the importance of “a high-tech infrastructure” as one of four pillars of innovation in the development of new enterprises. The physical system of an OKU must be comprised of the necessary electronic hardware and software, and an associated administrative system which is designed and distributed to meet geographic and economic needs of the populace. The concepts and technology today are developing rapidly. The full spectrum of these developments is not presented here. However, it appears that a number of foreseeable problems can be resolved by the new XML.

### ***The Extensible Markup Language (XML)***

In a letter to developers and information technology professionals regarding XML,

Microsoft Chairman Bill Gates (2000) stated:

What will the next generation of the Internet look like? Many of us envision an online world where constellations of PCs, servers, smart devices and Internet-based services can collaborate seamlessly. Businesses will be able to share data, integrate their processes, and join forces to offer customized, comprehensive solutions to their customers. And the information you or your business needs will be available wherever you are - whatever computing device, platform or application you are using . . . Solving such problems is the key challenge for the next generation of the Internet. At the heart of the solution is Extensible Markup Language, or XML. An open industry standard maby the World Wide Web Consortium, XML enables developers to describe data being exchanged between PCs, smart devices, applications and Web sites. Because XML separates the underlying data from how that data is displayed, the data itself is "unlocked" so that it can easily be organized, programmed, edited and exchanged between any Web sites, applications and devices. XML is a lingua franca for the Internet age. Just as the Web revolutionized how users talk to applications, XML transforms how applications talk to each other.

The developments just described can solve problems such as cross-references between the OKU cell content and the O\*Net as well as many other similar situations that are sure to arise. The timing is fortunate.

### *Table and Domain Considerations for OKU Databases*

Date (1982, 8) states that "the term 'entity' is widely used in database systems to mean any distinguishable object that is to be represented in the database." As mentioned earlier under the general discussion of the conceptual schema for OKU databases, such entities are described in tables consisting of domain columns. A number of additional business related entities are candidates for study as possibly useful database tables or column domains within tables in the development of OKUs. The following citations are some of the most significant examples of tables and domains we can suggest at this time for such consideration:

- A domain listing of external entities common to individual business entities including competitors, complements, customers, regulators, and strategic alliances, as well as suppliers of capital, funding, inventory and labor. (Bell 1999) A domain listing of common functions of managers including planning, organizing, staffing, directing, coordinating, reporting, and budgeting. (Huse 1979, 25)
- A standards table useful in classifying other knowledge items to be included in OKU cell content. All such items will, in a sense, constitute a "standard" (Sivan 1996) for the workplace. The complete system which Dr. Sivan depicts as useful in formulating, analyzing, and evaluating as well as classifying standards, is fully

explained in the reference. He quotes a classic definition of standards:

A standard is a formulation established verbally, in writing or by any other graphical method, or by means of a model, sample, or other physical means of representation to serve during a certain period of time for defining, designing or specifying certain features of a unit or basis of measurement, a physical object, an action, a process, a method, a practice, a capacity, a function, a duty, a right, a responsibility, a behavior, an attitude, a concept, or a combination of these, with the object of promoting economy and efficiency in production, disposal, regulation and/or utilization of goods and services, by providing a common ground of understanding among producers, dealers, consumers, user, technologists, other groups concerned. (Sivan 1996, 13)

Dr. Sivan's advanced standards system, presented in a very interesting format, is fully relevant to the present article in its focus on the interface of business, education, and technology in the knowledge age. It includes five basic domain columns as shown below. The subcategorized entries for each domain column as shown in parentheses would provide information with regard to the status of the knowledge item considered to be setting a standard.

- Level [applicability] ---  
(individual, organizational, associational, national, and multinational)
- Purpose ---  
(simplification, communication, harmonization, protection, and evaluation)
- Effect ---  
(constructive, positive, unknown, negative, and destructive)
- Sponsor ---  
(devoid, nonsponsored, unisponsored, multisponsored, and mandated)
- Stage ---  
(missing, emerging, existing, declining, and dying)
- A matrix of domain items that are applicable to 'enterprise architecture' -- which we understand to be the planning, development, and rules for operating an enterprise to achieve its objectives over its entire lifetime. The matrix includes the use of a set of categories corresponding to the 'who, what, when, where, why, and how' concept as one dimension. The second dimension is a list of those with main responsibility for achieving startup of the enterprise and maintaining it through its lifetime. These individuals include the planner, owner, designer, builder, and subcontractor. The content of cells in this matrix

comprises applicable “business rules” for the enterprise, a subject on which Zachman (1997) has written extensively. His matrix is a possible basis for part of the domain structure useful in organizing material within the cells of the database of the knowledge utility we are proposing.

There are many approaches and many conceptual schemas that must be developed to best present the information needed in each of the cells of the huge basic matrix of industries and worker positions we have proposed for OKUs. Further research and effort in the subject matter by educational and training experts will be required.

### *The OKU Design Framework*

An article from the Harvard University Center for Information Policy Research, proposing “Nine Keys to a Knowledge Infrastructure” (Sivan 2001), provides an excellent analytic framework for use in organizational knowledge management. A brief review of the above-mentioned article from the Harvard website is as follows:

Knowledge management (KM) is emerging as an activity that demands increasing attention from management in today's knowledge-based organizations. Since the early 1990s there has been a flood of both theoretical work on various aspects of KM and practical hands-on efforts in KM. As is frequently true of emerging fields, a bridge between theory and practice may be missing, but too often, KM theory highlights only parts of practical KM efforts, generalizes too broadly for use by an actual organization, or lacks value for people in the organization's trenches. To bridge theory and practice, this work proposes a unified analytic framework for KM, a framework that will allow organizations to plan, implement, and evaluate their knowledge management activities. The proposed framework consisting of the ‘nine keys’ to a knowledge infrastructure is designed to be simple enough to work with and powerful enough to generate insights about knowledge management that will lead to productive action.

This framework can be usefully applied also in evaluating database domain requirements, content, technology, and many other aspects of the development of an OKU.

### **FUNDING FOR THE OKU**

There are several ways in which the development of OKUs might be funded.

Public funding would provide the potential for improving national economies, and indeed the global economy, thus warranting investment by governments of the world. Private alternatives also exist. In this section we begin by describing an example of a public investment in highway transportation. We then point out some other ongoing public and private trends as alternatives and conclude that, if all else fails, an approach through the open source movement might accomplish the development of OKUs, which is greatly needed by the world economy today.

### *The United States Interstate Highway Example*

A national OKU could be established, maintained, and regulated by the federal and state governments in a manner similar to that established for the development of the U. S. Interstate Highway System in the 1960s. In this respect, by strong analogy, the utility could provide economic and social benefits similar to those of the U. S. highway system. The latter has proven to be one of the most beneficial government investments of the twentieth century. The national OKU could aid in fulfilling the promise of the Internet in the twenty-first century. Other government programs which are also directed at workforce and small business development, such as "welfare to work" training can be aided and enhanced by the utility.

### *The Digital Promise Project Example*

A number of suggestions for organizing and funding similar proposals are no doubt forthcoming. As an excellent example, we reference an article from the website of the "Digital Promise Project" (Grossman and Minow 2001). The authors point out the benefits to America of three bold public investments in an educated citizenry. These were:

- (1) The Northwest Ordinance, 1787 which "set aside public land to support public schools in every new state,"
- (2) The Morrill Act, 1862 which "led to the establishment of 105 land grant colleges," and
- (3) The GI Bill, 1944 which "made the United States 'the best-educated country in the world,' according to historian Stephen Ambrose."

Grossman and Minow (2001) "propose a fourth bold investment to advance the great legacy of those earlier initiatives." Their recommendation continues, in very convincing terms, to propose "the creation of a multibillion-dollar Digital Opportunity Investment Trust." The specific recommendation is for "the creation of the Digital Opportunity Investment Trust (DOIT), a nonprofit, nongovernmental

agency designed to meet the urgent need to transform learning in the 21st century . . . . DOIT will do for education what NIH does for health, NSF does for science, and DARPA does for national defense.” The website goes on to state:

For example, DOIT will commission research and fund the development of models and prototypes to:

- Train teachers in the best uses of new information technologies.
- Digitize America’s collected memory stored in our nation’s universities, libraries, and museums to make these materials available for use at home, school, and work.
- Develop learning models and simulations that invite the learner to explore a virtual solar system, an authentic three-dimensional model of the human body, a realistic trip to Mars, or a historic recreation of Mark Twain's America.
- Create voice-sensitive computer programs to teach language to new immigrants as well as fourth graders.
- Create inviting training materials for workforce development, adult learning, skills improvement, and civic engagement.
- Develop programs that measure the learning progress of individual students so teachers can adjust their teaching to the specific needs and abilities of each learner.
- Utilize new technologies to disseminate the best of our arts and culture locally, regionally, nationally and even globally.

In order to provide funding the website states that, “The proposed Trust will be financed by revenues earned from investing \$18 billion received from the mandated FCC auctions of the radio spectrum. This parallels the historic use of revenues from the sale of public lands, which helped finance public education in every new state and created the great system of land-grant colleges voted by Congress and signed by President Lincoln during the darkest days of the Civil War.” (Grossman and Minow 2001) Thus the proposal sets out a practical method of funding, and describes its purposes in broad terms. It could possibly include the proposal of this presentation for OKUs.

### ***Private Enterprise Participation***

It should be noted that the private sector is also making efforts regarding the current problems addressed herein. This is indicated, for example, in certain statements of Steve Case, CEO of AOL Time Warner, [From notes, not direct quotes --- May 5, 2001 on the TV program 'CSPAN' during an interview by David Frost] regarding the digital divide to the following effect:

- We must work on this - we cannot leave people behind.
- AOL has established a 'Power-Up Board' working on 'community technology

- centers' [to help solve the problem].
- The problem is beyond the capability of one company to solve [implying other companies must also work on the problem].
  - The problem is such that the Government can't deal with it on a comprehensive basis. We must be partners with the government and work with them.

### ***A Fall Back Position --- the Open Source Movement***

We will mention only briefly another possibility of achieving the development of an OKU. It could be possible through the formation of virtual communities on the Internet of altruistic individuals and groups. These communities would apply the 'open source' techniques described in a book on the subject by one who terms himself, in the title, as an "accidental revolutionary." (Raymond, 1999, 63) He begins with the development of the Linux computer operating system. His last-paragraph summary is, "I expect the open source movement to have essentially won its point about software within three to five years. Once that is accomplished, and the results have been manifest for a while, they will become a part of the background culture of non-programmers. At that point it will become more appropriate to try to leverage open-source insights in a wider domain." In the event public funding doesn't prove to be feasible we may well need this approach earlier than Raymond predicts.

Clearly private industry and the public will be aware of the risk in government participation, i.e., the degree to which OKUs will be accepted or ignored by potential beneficiaries of the material that will be made available. The answer lies in the attainment of another ingredient -- motivation -- as discussed below. However, it is also clear that the project is in the category of those meriting funding by the federal government under well-established criteria.

### **MOTIVATION FOR ACHIEVEMENT OF AN OKU**

Michael Dertouzos (1999) stated that successful achievement of innovative programs requires a "passion-oriented culture" within the organizing group. It appears nations, and even more so, the international body of nations needs OKUs --- systems to maintain comparative advantages in world trade in the Knowledge Age. The systems developed should be shared with trading partners, and provide a model for all nations in order for all to continue to reap international trade benefits and sustain desirable trade and international relationships. It will require common sense, along with the application of emerging Internet electronic technology and knowledge utility concepts to the problems of:

- improving the workforce;
- encouraging new and competitive small business;
- providing fair and equitable markets in world trade; and
- helping provide the globalization of peace and prosperity.
- aiding to provide the globalization of peace and prosperity.

In any event, the potential of appropriate OKUs to aid in solving these problems should be enough to arouse the passionate support of all cultures and populations of the world.

## SUMMARY AND CONCLUSIONS

In light of the foregoing, our conclusions can be summarized very briefly.

- *Need:* Workers and individual entrepreneurs who seek to enter into new and innovative businesses need knowledge to accomplish their objectives, which will in turn improve world economic conditions and promote peace.
- *Solution:* The solution we propose to meet the need is the development of Internet occupational knowledge utilities based on an overall database matrix framework consisting of two dimensions, or appropriate equivalents thereof. First is the North American Industry Classification System listing of manufacturing and service businesses, and second, the list of position descriptions commonly associated with the organization of businesses. The cells of the matrix must contain clear, accurate, timely, and verified information -  
- knowledge items -- on the processes of products and services which knowledge workers are to produce and distribute.
- *Technology:* Internet technology is developing very rapidly. We have outlined the applicability of the programming developments including:
  - relational databases including the existing Department of Labor O\*Net, and other public as well as private programming in progress;
  - expert systems and the possibility of other artificial intelligence programming;
  - the Extensible Markup Language (XML) for the Internet which will facilitate interchange of data between databases and facilitate OKU development; and
  - the development of infrastructures and systems for knowledge management which can be applied in public as well as private knowledge utilities.
- *Funding:* As always, this is a critical factor in accomplishing business and national economic projects. We believe that publicly funded OKU projects will benefit national and international economies in a cost effective and efficient way, and that they cannot be accomplished by private enterprise or the market system.

These projects are primarily education- and training-related. The driving force in attaining such funding, therefore, may have to come from leaders in the educational and training disciplines who know the benefits that accrue to people through their efforts.

- *Motivation:* The motivation for the OKUs stems from the economic conditions that prevail in the world and the need for social justice and peaceful solutions in many cases.

The problem of motivation of users of the systems is common in all educational and training situations. However, we believe OKUs will be welcomed by most of the populations and cultures of the earth.

Finally, as a tribute to Dr. Michael D. Dertouzos, whose death occurred at the time of this writing and whose work related to much of our research and thinking through its humanistic insight into the role of technology in economics and business, we include the following from his article on “The Future of Computing” in *Scientific American* in August 1999:

“ . . . as we focus our technologies increasingly on human needs, perhaps we can make a bigger wish for the future. The first three socioeconomic revolutions were all based on things -- the plow for the agrarian revolution, the motor for the industrial revolution and the computer for the information revolution. Perhaps the time has come for the world to consider a fourth revolution, aimed no longer at objects but at understanding the most precious resource on earth -- ourselves.”

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